

### Claims

1. Sample device (1) suited to be inserted inside an external tube (10) with a radius  $r_{\max}$ , comprising  
a turntable (4) with a substantially circular plate (40) having a radius  $r_{\text{table}}$ ,  
a rotator for rotating said turntable (4) around two substantially orthogonal axes (11, 12),  
two substantially coaxial tubes (2, 3), the turntable (4) being supported by the outer tube (3), and  
two meshing gears (20, 30), the first gear (20) being connected to the inner tube (2) and the second gear (30) being connected to the turntable (4), the first gear (20) having a radius  $r_{\text{gear1}}$ , the second gear (30) having a radius  $r_{\text{gear2}}$  and the inner tube (2) having a radius  $r_{\text{inner tube}}$  such that
$$r_{\text{table}} \leq r_{\max} - d \sqrt{1 + \frac{1}{n^2}},$$
with  $d$  being the gear thickness and  $n$  being the gear transmission ratio.
2. Sample device according to claim 1, characterized by  
at least one first cable guide (5) having a first end (51) connected to the turntable (4) and the second end (53) connected to a cable support.
3. Sample device according to claim 2, characterized in that  
the cable support is guided by the outer tube and/or connected to at least one synchronizing means and/or at least one first driving unit.
4. Sample device (1) suited to be inserted inside an external tube (10) with a radius  $r_{\max}$ , comprising  
a turntable (4) with a substantially circular plate (40) having a radius  $r_{\text{table}}$ ,  
a rotator for rotating said turntable (4) around two substantially orthogonal axes (11, 12),  
at least one supporting means for supporting the turntable (4), and  
at least one first cable guide (5) having a first end (51) connected to the turntable (4) and the second end (53) connected to a cable support, said cable support being connected to at least one first driving unit.
5. Sample device according to claim 4, characterized in that  
the supporting means comprises an outer tube (3).

6. Sample device according to claim 4 or 5, characterized in that an inner tube (2) is coaxially arranged within the outer tube (3), preferably at least one gear being arranged between the inner and the outer tube.
7. Sample device according to claim 6, characterized by two meshing gears (20, 30), the first gear (20) being connected to the inner tube (2) and the second gear (30) being connected to the turntable (4), preferably the first gear (20) having a radius  $r_{\text{gear1}}$ , the second gear (30) having a radius  $r_{\text{gear2}}$  and the inner tube (2) having a radius  $r_{\text{inner tube}}$  such that  $r_{\text{table}} \leq r_{\text{max}} - d \sqrt{1 + \frac{1}{n^2}}$ , with  $d$  being the gear thickness and  $n$  being the gear transmission ratio.
8. Sample device according to one of the claims 4 to 7, characterized in that the cable support is guided by the supporting means, in particular the outer tube, and/or connected to at least one synchronizing means.
9. Sample device according to one of the preceding claims, characterized in that the gear thickness  $d$  is the thickness of the first or second gear, preferably corresponding to the thickness of the inner tube.
10. Sample device according to one of the preceding claims, characterized in that the gear transmission ratio  $n$  corresponds to  $r_{\text{inner tube}} / r_{\text{gear}}$ , with  $r_{\text{gear}} = r_{\text{gear1}}$  or  $r_{\text{gear2}}$ , preferably  $r_{\text{gear1}} = r_{\text{gear2}}$  and/or  $r_{\text{gear1}} = r_{\text{inner tube}}$ .
11. Sample device according to one of the claims 2 to 10, characterized in that the first cable guide (5) comprises at least one first bellow (52) and/or spring, preferably between the two ends (51, 53), in particular the first end (51) being arranged substantially perpendicular to the second end (53).
12. Sample device according to claim 11, characterized in that the first bellow and/or spring is guided by a support, preferably connected with the outer tube.
13. Sample device according to one of the claims 2 to 12, characterized in that the cable support is provided with at least one external second bellow and/or spring.

14. Sample device according to one of the preceding claims, characterized in that the inner tube and/or the outer tube is/are connected to at least one second driving unit.
15. Sample device according to one of the preceding claims, characterized in that the rotator comprises the inner tube (2), the outer tube (3) and/or the cable guide (5) connected to at least one driving unit, in particular the first and/or second driving unit(s).
16. Sample device according to one of the claims 3 to 15, characterized in that the driving unit, in particular the first and/or second driving unit(s), comprises at least one stepper engine and/or at least one worm wheel and/or at least one gear.
17. Sample device according to one of the preceding claims, characterized in that the outer tube (3) is provided with at least one axial extension (31a, 31b, 33) for supporting the turntable (4).
18. Sample device according to claim 17, characterized in that the extension (31a, 31b, 33) is provided with at least one recess (32, 34) for carrying at least one first bearing (62, 63) and/or the cable guide (5), the turntable (4), in particular a rotation pin (42, 43) connected to the substantially circular plate (40), and/or the cable guide (51, 52) is/are mounted within at least one first bearing (62, 63).
19. Sample device according to claim 17 or 18, characterized in that the outer tube (3) is provided with two opposite extensions (31a, 31b, 33) for carrying at least two rotation pins (42, 43).
20. Sample device according to one of the preceding claims, characterized by a second bearing (61) between the inner tube (2) and the outer tube (3).
21. Sample device according to one of the preceding claims, characterized in that the first and second gears are formed as tooth or roll gears, and/or the first and second gears are formed as straight and/or conical gears.
22. Sample device according to one of the preceding claims, characterized in that the first gear (20) is machined on or mounted on the inner tube (2), and/or the second

gear (30) is machined on or mounted on the turntable (4), in particular a support (44) extending substantially perpendicular to the plate (40) and/or substantially coaxially to at least one rotation pin (42, 43).

23. Sample device according to one of the preceding claims, characterized in that the inner tube is made from carbon fiber and/or provided with chrome plated teeth, and/or the turntable is made from carbon fiber and/or provided with chrome plated teeth.
24. Sample device according to one of the preceding claims, characterized in that the first and/or second gear is/are made of acetal.
25. Sample device according to one of the claims 9 to 24, characterized in that the first and/or second bellow is/are made out of rubber, and/or the first and/or second spring is/are made out of non magnetic metal, preferably comprising copper, like copper beryllium, or plastic.
26. Sample device according to one of the preceding claims, characterized by at least one thermal isolation layer between the external tube and the outer tube, the thermal isolation layer preferably being evacuated.
27. Sample device according to one of the preceding claims, characterized by means for blowing a gas, in particular conditioned air, into the external tube, preferably the gas entering into the inner or outer tube and exiting the outer or inner tube.
28. Sample device according to one of the preceding claims, characterized by a control unit connected to the first and/or second driving unit.
29. Sample device according to one of the preceding claims, characterized in that at least one test object, at least one sample, at least one sensor, at least one mirror, at least one camera, at least one tool and/or at least one electronic device is/are, preferably detachably, attached to the turntable, in particular at least one side of the substantially circular plate, and/or connected with the control unit.
30. Sample device according to claim 28 or 29, characterized in that the control unit is arranged remote from the turntable, preferably at least one cable, in

particular guided at least partially within the first cable guide, being provided between the control unit and the turntable.

31. Sample device according to one of the preceding claims, characterized by at least one second cable guide, preferably connected to the second end of the first cable guide, in particular being substantially flat and/or flexible.
32. Sample device according to one of the claims 29 to 31, characterized in that the sensor comprises at least one coil and/or at least one magnetic sensor, in particular for providing a magnetic calibration device.
33. Sample device according to one of the claims 29 to 32, characterized by a source for emitting, preferably electromagnetic, radiation, in particular comprising a laser and/or a visible light source.
34. Sample device according to claim 33, characterized in that the radiation is guided to the turntable, in particular to the mirror and/or camera, preferably within the inner tube, in particular via at least one glass and/or fiber-optic light guide or waveguide.
35. Sample device according to one of the preceding claims, characterized in that the amount of turns of the inner tube differs from the amount of the turns of the outer tube by one turn within one cycle, in particular measuring or calibration cycle.

Reference sign list

1	sample device
2	inner tube
3	outer tube
4	turntable
5	cable guide
10	external tube
20	gear
30	gear
31a, 31b	extension
32	recess
33	extension
34	recess
40	plate
41	recess
42	rotation pin
43	rotation pin
44	support
51	guiding tube
52	guiding bellow
53	guiding tube
61	bearing
62	bearing
63	bearing
A1	rotation axis
A2	rotation axis
A3	rotation axis
R1	rotation direction
R2	rotation direction
R3	rotation direction